



Specification for ITS Control Cabinet “Piggyback” Mounted Uninterruptable Power Supply

City of Mesa Transportation Department

Traffic Engineering

Intelligent Transportation Systems Group (ITS)

Traffic Signal UPS Specification
Piggy Back Mounted Cabinet
For The City of Mesa Arizona
Revised 9/23/09

General Requirements

This Traffic Signal Uninterruptible Power Supply (UPS) shall be a turnkey, piggy back mounted (shall be bolted to the backside of the traffic signal cabinet), and be designed for outdoor use in extreme environments. The Traffic Signal UPS shall operate up to its rated power with existing traffic signal equipment, including any and all signal heads. The Traffic Signal UPS shall be capable of supplying an 840 watt load a minimum, **3.0 hours** of normal operation and 2.0 hours of flashing operation, at its maximum power rating from -40 degrees Celsius to 55 degrees Celsius outdoor ambient temperature. Traffic Signal UPS shall be furnished and installed in conformance with the following specification.

Scope

- The Traffic Signal UPS shall operate as line interactive with buck boost functionality. **The solid state inverter shall be an Alpha FXM1100, in order to maintain interchangeability with our current UPS inverters and to maintain a standard method of communicating with the units.** It shall also include a fail-safe bypass system; integral automatic **electronic** transfer switch, **electronic generator transfer switch** and battery subsystem. The specified equipment herein shall be referred to as a UPS.
- Transfers to and from battery operation shall not interfere with operation of other equipment in the intersection.
- Primary application of the UPS is to provide emergency power for traffic control signal systems. The UPS must supply up to a 7.0amp 120 VAC, 60 Hz continuous load for a minimum of 2.0 hours normal run time and a minimum of an additional 2 hours of flash time.
- The UPS shall transfer the intersection to flash mode via programmable form C relays, accessible through a terminal block to provide for connection for control wiring to the traffic signal cabinet.
- Primary input power source to the UPS shall be utility power.

System Description and Operation

- The Traffic Signal UPS shall consist of a power conditioning and interface device, battery charger, inverter, batteries, fail-safe bypass, integral automatic transfer switch, protective devices, and monitoring circuitry as specified herein. The Traffic Signal UPS shall automatically assure continuity of conditioned and Automatic Voltage Regulated (buck-boost functionality) without switching to the batteries to keep the operating load voltage between 85-173VAC. Continuity of conditioned, Automatic Voltage Regulated power to the critical load shall be maintained when input power is lost and until input power returns within specifications or until the batteries have been discharged.
- In the instance of a power outage lasting longer than the UPS is capable of supplying power in standby mode, the UPS system shall be capable of automatically qualifying power and returning to normal mode of operation when line power returns.
- The UPS and the Batteries must be hot swappable. There shall be no disruption of the Traffic Signal when removing the UPS or batteries for maintenance.
- The Inverter shall be equipped with an industry standard, I.P. addressable, Ethernet RJ45 port for programming and remote monitoring. Programming and communications firmware shall be written to run under Windows XP, 2000 or Vista's Internet browser, Internet Explorer. Inverter programming & Alarms shall also have the ability to be monitored via Ethernet using SNMP protocol. The unit shall be capable of sending alarms to alert Traffic Management Operators of an incident with the UPS assembly.

Modes of Operation:

- *Normal:* The UPS shall continuously supply power to the critical load. The charger shall supply temperature compensated DC power to the batteries. The charger shall maintain the batteries in a fully charged state even at low input voltage conditions. The batteries shall remain fully charged.
- *Emergency:* Upon failure of the input AC power source, the critical load shall be supplied by the UPS, which shall obtain its power from the batteries through the Automatic Transfer Switch and Inverter. There shall be no interruption or disturbances to the critical load upon failure or restoration of the input AC power source.
- *Recharge:* Upon restoration of the input AC power source (prior to complete battery discharge), the UPS shall automatically return to normal operation. If the batteries become completely discharged (batteries have reached the DC cutoff point) the UPS shall automatically restart and resume normal operation including the automatic recharge of the batteries once utility power is restored.
- *Fail-safe Bypass Mode:* In case of UPS failure, the critical load shall continue to operate on utility power. There shall be no disruption of the critical load.
- *Downgrade:* If the batteries are to be taken out of service for maintenance, they shall be disconnected from the UPS by means of a battery circuit breaker and Anderson quick disconnect. The UPS shall continue to function as specified, except for power outage protection and dynamic response characteristics.

Major Components

- *An Electronics Module:* The Traffic UPS shall be capable of providing continuous, fully conditioned, regulated, pure sinusoidal (AC) power to the traffic control signal system during all modes of operation (except when the UPS is in bypass).
- *Charger:* The charger shall be of solid-state construction. The charger shall rectify AC power to regulated DC power for the batteries. This shall be an automatic function. The charger should be a 3 stage temperature-compensated charger so that the charger level for the batteries is automatically adjusted based on internal ambient temperature.
- *Inverter:* The inverter shall be of solid-state construction. In case of the loss of input power, the inverter shall convert DC power from the batteries to AC power.
- *Fail-safe Bypass:* The bypass shall consist of a fail-safe design. In case of UPS failure (UPS output power not present); the fail-safe bypass shall automatically transfer power for the traffic control signal system to the bypass source.
- *Batteries:* Upon loss of input power, the batteries shall supply DC power to the inverter.
- *Status display shall at a minimum be provided for:* 1) AC Line Present; 2) Battery Charger; 3) UPS Output Power Present; 4) ON Battery 5) Buck and boost monitoring
- *Status Monitoring and Alarm Transmission:* The Inverter shall include remote monitoring & alarm transmission capabilities through an Ethernet RJ45 IP Addressable Port using the SNMP Protocol. As a minimum, the Inverter shall contain the following monitoring and transmit the following alarm functions: 1) Input power present (System in Stand-By mode); 2) UPS on battery operation; 3) Low battery condition

Protection

- The UPS shall have a main input circuit breaker for over current protection.
- The UPS assembly must be reasonably protected and provide lightning protection and surge suppression meeting ANSI/IEEE C.62.41/C.62.45 Cat A&B
- The battery subsystem shall be protected by a circuit breaker.

Battery System:

- The battery shall be comprised of extreme temperature, float cycle, GEL VRLA (Valve Regulated Lead Acid) 5 year non pro-rated warranty minimum.
- The battery system shall consist of one or more strings (typically 2 or 4 batteries per string) of extreme temperature; float cycle GEL VRLA (Valve Regulated Lead Acid) batteries. Batteries shall be certified to operate at extreme temperatures from -40°C to $+74^{\circ}\text{C}$.
- The battery interconnect cables shall connect to the inverter via a **single** quick-release Anderson Connector. **No other connectors are to be used in the battery harness.**
- Battery construction shall include heavy-duty, inter-cell connections for low-impedance between cells, and heavy-duty plates to withstand shock and vibration.
- The top cover shall use tongue and groove construction and shall be epoxied or heat-sealed to the battery case for maximum strength and durability.
- The battery shall function if laid on its side without the leakage of chemicals and be so designed.
- An integral lifting handle should be provided on the batteries for ease of removal/installation.
- An electronic “**Battery Manager**” shall be included to monitor and protect the batteries by spreading the charge voltage equally across all the batteries in the string, ensuring that every battery is properly charged. This will ensure an ideal voltage across each battery optimizing life and runtime.

Generator Transfer Switch, Generator Outlet and Automatic Transfer Switch

- The cabinet shall be equipped with an electronic generator transfer relay with manual bypass switch and a Hubble/Bryant model 70520MB, 20A 125VAC locking flanged inlet located within the generator compartment, so that an emergency generator can be connected to the line side of the cabinet. The electronic generator transfer relay will transfer the load, including the UPS to the twist lock receptacle. The electronic generator transfer switch shall be wired to prevent any back feed to the utility service. The generator outlet shall be enclosed behind a door integral to the cabinet with a closeable slot for the generator cord.
- Dry contacts shall be provided to monitor the generator transfer switch and shall be in the closed position when the switch is in the bypass mode.
- The unit shall also be equipped with an electronic Automatic Transfer Switch with manual bypass switch and equipped with dry contacts to monitor **the position of the manual bypass switch.**

Electrical Specifications

Input Specifications:

- Nominal input voltage: 120 VAC, single phase.
- Input voltage range: + 15 to -20% of nominal (85 to 173VAC).
- Input frequency: 60Hz +/-3 Hz. (5%).
- Input frequency slew rate: 3 HZ per second maximum.
- Input configuration: 2 -wire (“hot and neutral”) plus ground.
- Walk-in Delay: The UPS shall wait a minimum of five (5) seconds (user programmable) before returning to normal mode of operation upon restoration of input power. (This value may be programmable within the unit via software provided with the unit)
- Input protection: Single pole circuit breaker
- Power connection: Hard Wired (terminal block).
- All components, terminations, terminal blocks relays etc. shall be fully accessible. Nothing may block access to them.
- Inverter connections shall made on terminal blocks or shall be of the quick disconnecting type for ease of maintenance. Harnesses shall be terminated on terminal blocks.

Output Specifications:

- Power rating (continuous): minimum 1100W/VA, single phase 120VAC
- Output power rating shall be the same regardless of whether or not the UPS is in normal mode or emergency mode of operation.
- Nominal output voltage: 120 VAC $\pm 10\%$ no load to full load, $\pm 5\%$ high line to low line.
- Output configuration: 2 wire (hot and neutral) plus ground.
- Power Conditioning Common-Mode: -120 dB, Normal-Mode: -60 dB
- Grounding: Single Point Ground
- Output frequency: 60 HZ ± 3 Hz when synchronized with the input power.
- 60 HZ ± 0.5 HZ when UPS is running on internal clock.
- Output wave shape: TRUE Sine wave.
- Output voltage distortion with 100% linear load: 10% maximum THD with any single harmonic no greater than 5%
- Crest factor: 3: 1.
- Transfer time: Transfers to and from battery operation shall not interfere with the operation of the other equipment in the intersection. Transfer time shall be less than 10ms.
- Overload capability: 110% for ten (10) minutes, 150% surge.
- Fault condition: UPS shall withstand a short circuit on the output with no damage.
- Customer connection: Terminal block input and output. Terminal block or lug shall accommodate a #6-10AWG Copper wire and shall be clearly labeled LINE and LOAD.

Battery Specifications

- DC bus voltage: 48 VDC nominal
- Low battery cutoff shall be 42 volts DC
- DC under voltage cutoff: Battery Manufacturer's recommendations.
- Battery discharge time: Based on specific battery configuration. Engineering to specify the run times based on actual test data and empirical calculations. Times to be based upon an ambient temperature of between 70 and 80 degrees F.
- The charging voltage shall be based upon the ambient temperature within the UPS enclosure. Actual volts per cell shall be determined by best engineering practice to maximize battery life. This setting shall be factory set.
- Protection: Circuit breaker.

Fail-safe Bypass Specifications

- Rating 20amps at 120 VAC.
- Transfer time: 150 milliseconds maximum.
- Power source: Line side of the input circuit breaker.

Monitoring and Metering Specifications

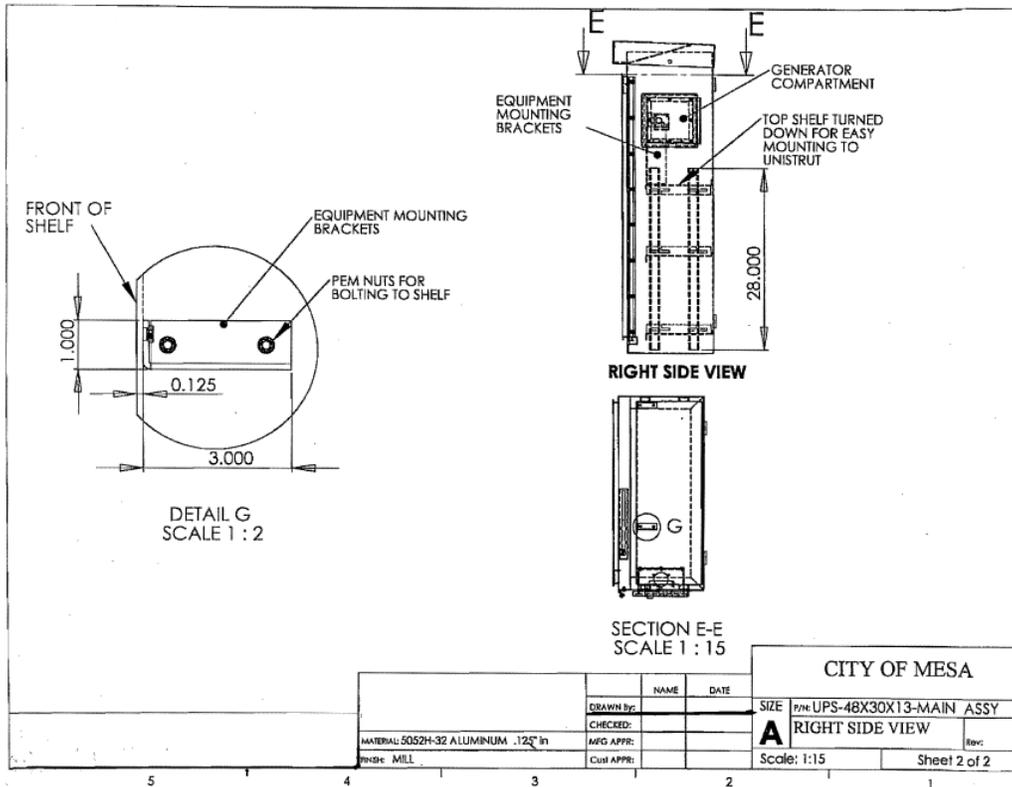
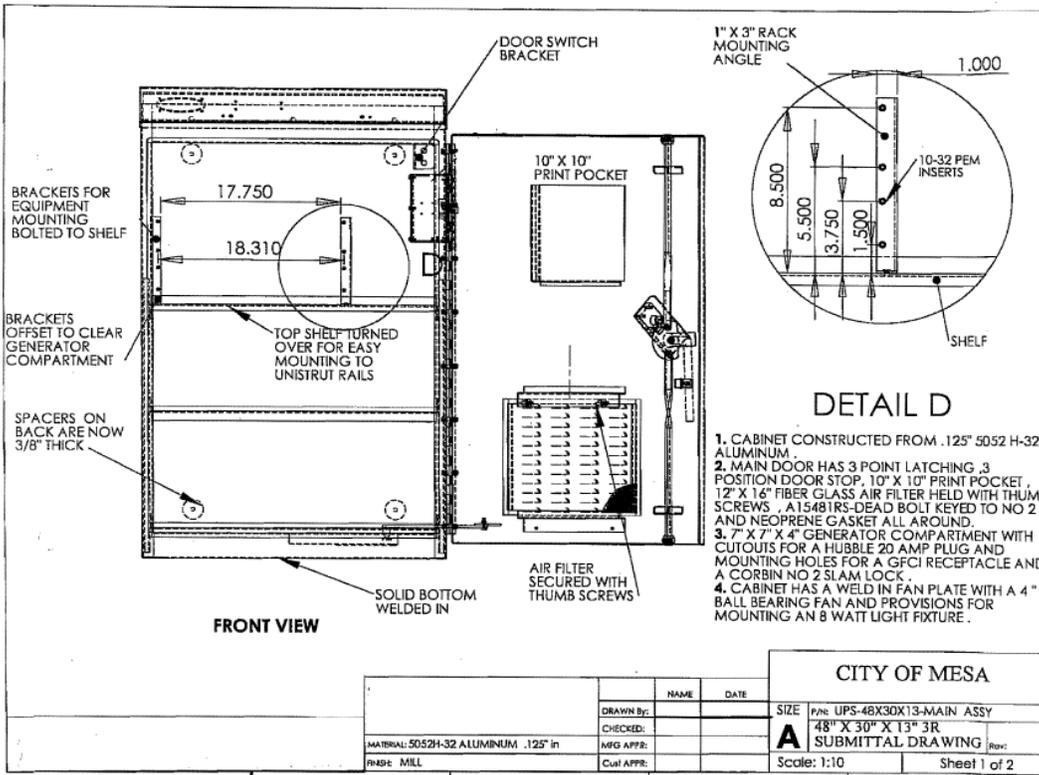
- Contact rating: 125volts (AC or DC) maximum, 1.00 amperes maximum, 50 VA / 30 watts maximum.
- Contacts shall be Form C.
- Customer connection: Terminal block.
- LEDs/LCD Display shall be visible in daylight.

Cabinet Specifications

(Refer to attached cabinet drawings)

- NEMA 3R 48" Tall, 30" Wide, 13" overall depth, fabricated from .125" thick 5052-H32 mill finish aluminum. All hardware, (door handle, door cam, hinges & hardware) shall be fabricated of 304 stainless steel. Solid bottom and shall bolt to the back of a standard Traffic Signal cabinet. No penetrations shall be made through the top of the cabinet. Any cabinet seams or plates not welded shall be sealed with RTV Clear Silicone Sealer.

- The cabinet shall be equipped and constructed as follows:
 - (1) ¾" diameter stainless steel pad-lockable handle
 - (1) #2 Corbin main door lock with two keys
 - (1) 3 point door latch, with nylon rollers for top and bottom strikers
 - (1) Automatic doorstop rod made of plated steel that can hold the door open at 90 degrees and up to 180 degrees.
 - Neoprene door gaskets
 - Louvers in main door with 12"x16"x1" fiberglass air filter held with thumbscrews.
 - Vent Slots on the underside of the over-hang. Over hang to slope from front to back
 - Fan plate with single thermostatically controlled 4" Comair Rotron **MX2B3** Ball Bearing **(or exact equivalent)** fan mounted to far left
 - Door switch and bracket shall be provided to activate a rapid self-starting fluorescent light fixture mounted on the fan plate. This fixture shall be wired to the load side of the UPS.
 - A GFI Protected Receptacle shall be mounted on the door and wired to the load side of the UPS for maintenance use.
 - 7"x7" Generator Compartment door, approximately a 4" deep compartment shall be provided and mounted on the right side of the cabinet with removable inner panel. A Hubble/Bryant model 70520MB, 120VAC 20amp locking flanged receptacle shall be mounted in the top of the generator compartment. The generator compartment shall incorporate a #2 Corbin slam lock and a ½"x1" window for extension cord slot. When not in use, the window shall be covered with a spring actuated sliding piece of aluminum.
 - Equipment rails shall be mounted vertically, for horizontally mounted equipment. The rails shall be drilled to match EIA 19" spacing, to provide support and mounting for the inverter and electronic Generator by-pass switch/Automatic Transfer Switch panel.
 - 2 reinforced shelves for the batteries shall be provided. These shelves shall be adjustable within the cabinet. These shelves shall be removable without the use of tools.
 - The mounting of the UPS to the Traffic Signal Cabinet (supplied by others) shall be such that the bolts/nuts are not accessible from the outside.
 - Permanent labels shall be located inside the enclosure. All labels shall be engraved or silk-screened. No paper or plastic labels shall be allowed.
 - An aluminum pocket shall be provided for the cabinet prints. **(Approx. 9" w x 6" Tall x 1.25" deep)**
 - 2 sets of cabinet wiring prints and the latest instruction/operation/maintenance manual shall be provided with each cabinet.
 - Line/Load Lugs: Shall be installed for AC+, AC- Chassis Ground. Lugs shall be capable of terminating #8-#10 Copper Wire. Service Lugs from Utility Power shall be clearly marked LINE. Service Lugs to the Traffic Signal Control Equipment shall be clearly marked LOAD.



Operating Environment

Temperature:

- The UPS assembly shall operate satisfactorily when the ambient temperature outside of the UPS enclosure is 0 degrees to 130 degrees Fahrenheit.
- Relative humidity: 0 to 95% non-condensing.

Reliability and Maintainability

- Mean-Time-Between-Failure (MTBF) shall be 80,000 hours. Mission MTBF, including bypass-switch, is 150,000 hours.
- The UPS shall be designed for ease of maintenance and serviceability.
- All components shall be accessible.

Maintainability

- MTTR (Mean-Time-To-Replace or Repair)
- Electronics: 15 minutes or less
- Battery System: 15 minutes or less

Warranty

- The Inverter manufacturer shall be ISO 9001 or ISO 9002 certified.
- Standard warranty: Terms are two-year parts and labor on the entire unit. F.O.B. City of Mesa. Batteries shall as a minimum have a 5-year unconditional warranty replacement. If warranty is greater please state in writing.